

2.0 SITE CHARACTERIZATION

Much of the information describing operational procedures at the Morning Star Mine was obtained from permit documents generated when the Bureau of Land Management had regulatory jurisdiction over the mine (VGC, 1994 and CCJM, 1996). In 1994 the National Park Service became responsible for administration of the site with the passage of the California Desert Protection Act. The Morning Star Mine produced gold and silver by using a dilute cyanide solution to separate the precious metals from crushed ore. Ore was trucked from the open pit to heap leach pads where a spray system applied the cyanide solution to the ore. The resulting “pregnant” solution, bearing the precious metals dissolved from the ore, was contained by the impervious liners of the pads and PSP then piped to the processing plant. The pregnant solution was passed through a carbon source, crushed coconut charcoal, and the precious metals adhered to the carbon. The precious metals were separated from the carbon by using caustic soda. In addition to the leaching and processing circuits, the mine also had an on-site laboratory to assay ore grades and a refinery to reduce the gold and silver into doré bullion.

2.1 Material Manufactured, Stored, or Disposed of on Site

According to documents submitted to the BLM, Vanderbilt Gold Corporation used 14 chemicals when the Morning Star Mine was operational. These included chemicals used to process the ore, conduct laboratory analyses, and refine the doré bullion. These chemicals included: sodium cyanide, lime, caustic soda, coconut charcoal, antiscalent, calcium hypochlorite, and sodium nitrate in the leaching, processing and detoxification circuits and borax, litharge, denatured alcohol, hydrochloric acid, acetone, nitric acid, and rhodamine in the laboratory (VGC, 1994).

Bulk chemicals were stored in the bulk-chemical storage area in the vicinity of the carbon plant. This storage area was underlain by a concrete slab and sloped so that the concrete ore processing vats would capture any large liquid spills. The Morning Star Mine used diesel generators to provide power. Gasoline and diesel were stored in above ground fuel tanks next to the generator building southeast of the barren solution pond (VGC, 1994).

2.2 Estimated Quantities of Contaminant and Potential Hazards

2.2.1 Water Quality Violations and Wildlife Mortalities

The site, located within a waterfowl migration route, experienced several recorded incidents, while active, regarding exceedances of state or federal water quality discharge standards and failure to comply with regulations to protect wildlife. Wildlife mortalities associated with the processing operations included waterfowl and a reptile; the CEO of VGC was subsequently convicted of eight counts of wildlife, water quality and waste discharge violations (CCJM, 1996).

Recent laboratory tests confirmed the presence of heavy metals and cyanide in the PSP (Harding ESE, 2002). Previous site assessments indicated that the liner under the PSP was degraded and was suspected of leaking (CCJM, 1996). The pond was relined in 2002. No site-specific investigations have been conducted to date to verify whether leakage occurred from the PSP liner system or whether hydrocarbon-contaminated soils are present on the site. Examination of soils in the vicinity of the diesel and gasoline storage tanks indicated elevated levels of total petroleum hydrocarbons (CCJM, 1996).

2.2.2 Process Chemicals

As detailed in Section 2.1, VGC used 14 chemicals during the process of producing gold doré bullion. Several of the chemicals used in the processing system, some of which are toxic, were delivered as a white powder in their standard industrial form. Operational BLM compliance records indicate piles of an unidentified “white powder” were noted on site without protective containment measures. Other incidents noted regarding housekeeping and waste management included improper waste disposal, trash and debris, assay and laboratory crucibles, paint waste, tires, and batteries. Unstable pit slopes and pit wall overhangs were also noted by the BLM (CCJM, 1996) and consultants.

2.2.3 Solution Containment

The addition of cyanide to Pad No.1 was discontinued in 1991. In 1993, VGC stated that heap leach Pad No.1 and the PSP had attained the detoxification thresholds required by the LRWQCB permit. The operator applied for a reclassification of these mine features to nontoxic mine waste status and the pad was downgraded and certified detoxified by the LRWQCB (CCJM, 1996). No state or federal agency oversight was present during the closure sampling conducted by VGC. However, recent sampling episodes (E & E, 1999 and HLA, 2000, 2001, and 2002) indicate the

presence of both Total Cyanide and WADCN above CA MCL and LRWQCB discharge limits in the heap leach pads and PSP.

In 1991 a leak developed in the upper liner of heap leach Pad No.2. Although the operator claimed that the integrity of the lower liner was not breached, the addition of cyanide to this Pad was terminated and detoxification of Pad No.2 was initiated (VGC, 1994). No data was available at the time of this report regarding any site investigation regarding the nature and extent of any solution loss as a result of this incident.

The mine submitted modifications to the ore processing and detoxification system (after four years of inactivity) prior to the transfer of administration from the BLM to the National Park Service (NPS); however, the BLM did not approve the modified Plan of Operation. BLM nominated the Morning Star Mine to the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) in 1994 based on the presence of hazardous waste on the site (CCJM, 1996).

2.2.4 Acid Base Accounting Investigation

As reported in the application to modify the Plan of Operations, at the direction of the LRWQCB, Vanderbilt Gold Corporation analyzed samples of waste rock from the Morning Star Mine waste rock dump for their acid generating potential. The purpose of this limited site assessment was to determine the potential for the waste material to generate acidic leachate during natural weathering and leaching (VGC, 1994). Acid base accounting is based on the premise that the likelihood for a site to produce acid mine drainage can be predicted by comparing the total amount of acidity and alkalinity within target bedrock strata. The percentage of acidity is stoichiometrically calculated from the percent sulfur in the rock sampled. The neutralization potential is determined to estimate how much of the acid is consumed by carbonates and other acid neutralizers present in the sample. Using EPA Method 600-12-78-054, this calculation is presented as tons of calcium carbonate (CaCO_3) per 1000 tons of rock.

Vanderbilt collected three composite grab samples from the waste rock dump, one sample each from the lower, middle and upper levels of the dump. Results of the sampling program analyzed by a California State Certified Environmental Testing Laboratory indicated no acid generating potential for any of the three samples analyzed (VGC, 1994). Based on these results, Vanderbilt

concluded that no potential existed for the rock material at the mine to generate acidic leachate during natural weathering and leaching.

Confirmatory analysis of heap leach pad material and waste rock was performed as part of the data investigation conducted for preparation of this document and is discussed in Section 5.

2.2.5 Gasoline and Diesel Storage

Gasoline and diesel were stored on a lined containment site next to the generator building. The Preliminary Assessment Report (CCJM, 1996) written to assess the site's potential threat to human health and the environment in accordance with CERCLA, indicated that this containment had been breached and that there was a strong likelihood of petroleum contamination on site. No further investigation has been conducted to verify the potential presence of petroleum contamination.

2.3 Structures/Topography

The elevation of the mine site is approximately 4,570 feet above mean sea level. Local relief is highly variable. The surrounding landscape is composed of native desert flora ecosystems, and granitic rock outcrops. The vegetation is composed of Joshua trees, creosote bush, various species of cacti, and desert needlegrass.

2.3.1 Facility Size/Dimensions

During operations, as reported on site plans submitted by the operator, the facilities at the Morning Star Mine were as follows (VCG, 1994):

- The open pit mine is approximately 800 feet square, 150 feet deep with 15 to 20 feet of surface water present in the pit.
- Mine support facilities included a vehicle maintenance shop, assay lab and office, refinery, administrative office trailer, a generator building, and a pump house.
- Miscellaneous equipment included a crusher, septic tanks, generators, fuel storage tanks, solution processing equipment, water tanks, water wells, helicopter pad, and security house.
- Several abandoned vehicles.

Pad No.1 (built between 1984 and 1985) is approximately 12.5 acres in size. The liner consists of six inches of compacted alluvium; a leak detection system of four inch perforated plastic piping, and a 40-mil HDPE liner. The leachate collection system consists of four inch perforated pipe on the liner connected to an eight inch perforated manifold draining into the PSP. The collection system was overlain with a geo-textile fabric and covered with two feet of crushed rock. Pad No.1 drained to a collection pond on the eastern edge of the leach pad. The pregnant solution was then pumped directly to a carbon filtration system. Following filtration, the solution was adjusted for cyanide and re-circulated.

Pad No.2 completed in 1989 is the only cell constructed of a proposed three-cell system. The leak detection system consists of four-inch perforated plastic piping installed on six inches of compacted alluvium. The perforated pipes were covered with a 40-mil HDPE liner and a second four-inch perforated piping system was installed on the HDPE. This liner was covered with a geo-textile fabric and another 40-mil HDPE liner. The leachate collection system consists of a four inch perforated pipe on the liner connected to an eight inch perforated manifold. This pipe runs from the southwest corner of the pad to the northeast corner of the pad and into an internal concrete lined sump and collection trough. The leachate collection system was covered with a geo-textile fabric and crushed ore. A submersible pump in the manifold pipe pumped the pregnant solution directly to the carbon filtration system.

When operating, the mine utilized four ponds: a fresh water pond, two barren solution ponds, and a lined PSP. Current site conditions indicate that the two leach pad liners and the PSP are still impounding water.

Groundwater beneath the site is described as occurring in irregularly discrete alluvial deposits and fracture zones in the Ivanpah Granite formation. During exploratory drilling, prior to the start up of the open pit mining operation, the presence of groundwater was noted at depths of over 200 feet bgs. Two supply wells produced water for operations from approximately 210 feet bgs: Well No. 1 - 350 feet northwest of Pad No. 2 and Well No. 2 - 800 feet northwest of the mine pit. By 1988 these two wells could not keep up with operational water requirements. As a result, two wells were drilled in the Ivanpah Valley, approximately five miles from the mine site. A water line was constructed to supply the mine site with water from these off-site wells (VGC, 1994). This pipeline has since been abandoned.

Five wells were also installed to monitor potential releases of solution to the ground water. Monitoring Wells MW-1, MW-2, and MW-3 are located on the north, east, and south side of PSP, respectively. MW-4 and MW-5 are located on the west and east sides of Pad No.2, respectively. The monitoring wells were drilled to bedrock and the bedrock/overburden contact was reportedly screened. Quarterly monitoring reports from the period 1985 through 1994 indicate mine monitoring wells, checked on a weekly basis for the presence of water, were dry during that period.

2.3.2 Boundary Descriptions

The site is in the north half of Section 28, Township 15 North, Range 14 East of the San Bernadino Baseline and Meridian. The mine is located on a landform locally known as Cactus Hill. The mine property was comprised of a series of unpatented mining claims. The claim boundaries are documented in permit materials submitted to the BLM by VGC (VGC, 1994).

2.3.3 Land Cover/Vegetation

A description of the vegetation in the project area (VGC, 1994) indicates that barrel cactus (*Ferocactus acanthodes* var. *acanthodes*) is restricted to the rocky slopes of Cactus Hill. Joshua trees (*Yucca brevifolia*) are found on both the rocky slopes and alluvial fans in the project area and the area is classified as Joshua Tree Woodland. Mojave yucca (*Yucca schidigera*) and Staghorn cholla (*Opuntia acanthocarpa*) were also noted.

The project area is a transitional zone with the Creosote plant community at lower elevations (VGC). This community type is composed of the creosote bush (*Larrea tridentata*), California wild buckwheat (*Eriogonum fasciculatum*), blackbrush (*Coleogyne ramosissima*), Cooper's goldenbush (*Haplopappus cooperii*), cat's claw acacia (*Acacia greggii*), Nevada Mormon tea (*Ephedra nevadensis*), and paper bag bush (*Salazaria mexicana*). Red brome (*Bromus rubens*), galleta (*Hilaria jamesii*), and Abu Mashi (*Schismus barabatus*) were identified as the common grasses.

2.3.4 Utilities/Transportation Features

There are no permanent utilities on site. During operation, the mine relied on generators to provide power. The remote Morning Star Mine is accessed via Interstate 15 in California near the Nevada border (Fig. 1). The route to the mine is east on Nipton Road (from the exit), south on Ivanpah Road, south west on Morning Star Road (all paved), and west-northwest on the dirt

access road to the mine site. The Morning Star Road is one of the most heavily traveled roads in the Preserve. San Bernardino County maintains an estimated 176 miles of paved road in the Preserve, including the Morning Star Road (NPS, 2002). The roads represent transportation features to the mine site and traverse lands that are either “critical” or “non-critical ” desert tortoise habitat (NPS, 2001).

2.3.5 Surface Water Bodies/Conveyances

Surface water, in the form of perennial springs or streams, is not present on the site.

2.3.6 Drainage Channels/Pathways

The stormwater drainage area for the leach pads and PSP is approximately 31.5 acres. The Operating Plan (VGC, 1994) indicated the presence of permanent stormwater diversions, however, these were not indicated on the site features maps available at the time this report was prepared. Storm water from precipitation events reports to two unnamed ephemeral washes that drain east towards the Ivanpah dry lake.

2.3.7 Historically/Archeologically Significant Features

No information regarding historically or archaeologically significant features was contained in the documents reviewed for this report.

2.3.8 Sewer Lines/Manholes

The presence of septic drainfields were mentioned in the Operating Plan (VGC, 1994), however location of these drainfields were not indicated on the site features maps available at the time this report was prepared. During operation, it is assumed that gray and black water were disposed of in a septic drainfield.

2.3.9 Stormwater Drainage Pipes

No stormwater drainage pipes were identified during 2001 and 2002 site visits and a review of aerial photographs.

2.3.10 Open Ditches/Canals

No open ditches or canals have been identified on the site to date.

2.3.11 Power lines/Pipelines

No power lines were associated with this project. When the mine was in operation, diesel generators provided power.

A six-inch, 26,000 foot long pipeline was constructed to conduct groundwater from wells located east of the mine to the project site. See Section 2.4.1 for a discussion of all production wells used for operations.

2.4 Geology/Soil Information

The Morning Star mine is located in the southwestern extension of the Basin and Range Physiographic Province, just east of the Mojave Structural Block. The regional geology is complex with several regional strike slip and normal faults occurring near the mine site (VGC, 1994). The east verging, northwest striking Morning Star Thrust Fault extends through the mine. The Morning Star ore body is encased in Ivanpah Granite in the hanging wall of the Morning Star Thrust Fault. The Ivanpah Mountains are composed of mid-Mesozoic plutonic rocks ranging from granite to quartz monzonite. Gold mineralization at the Morning Star Mine was generally low grade and disseminated; however, it did contain pockets of relatively high-grade ore (CCJM, 1996).

2.4.1 Depth to Aquifer

Regionally, ground water flows in an easterly direction toward the Ivanpah Valley. A major aquifer is located below the Ivanpah Valley five miles east and approximately 2,091 feet lower in elevation than the Morning Star Mine. Groundwater occurrence beneath the site itself is irregularly present in alluvial deposits, and joint, fault, and fracture zones within the Ivanpah Granite. Water encountered during exploratory drilling typically occurred below 200 feet bgs. Prior to July 1988 two onsite wells pumped water from approximately 210 feet bgs. A 1984 Waste Discharge Information Report from VGC indicated that the ground water source for the onsite wells was an alluvial formation uphill from the pads and that no hydrologic continuity existed between the wells and the pads and the PSP. However, no collaborative information was submitted to substantiate this statement (CCJM, 1996).

By early 1988, the onsite wells had ceased producing. VGC drilled two offsite water production wells in the Ivanpah Valley in 1988. The wells are located approximately four miles east of the PSP. Operator data indicates the wells were drilled to 700 feet (Well No.1) and 720 feet (Well No.2). Standing depth to water was 538 feet and 562 feet after completion of the wells and the pumps were set at 636 feet and 648 feet, respectively. These wells were completed in an aquifer approximately 640 feet bgs and produced 160 gpm 12-hours per day (VGC, 1994). Water quality analyses on the wells indicate elevated TDS (1,044 mg/l) and fluoride (1.7 mg/l) (CCJM, 1996).

No known springs are located in the vicinity of the mine site. The nearest spring, Mineral Spring, is located approximately 3.4 miles northeast of Pad No.1.

No sole source aquifer has been identified within the ground water migration pathway target area (CCJM, 1996).

Recently collected on site groundwater elevation data gathered for this document is presented in Table 3.3 and a comparison of water table elevation with the pit surface water elevation in Table 5.2. Additionally, there is a discussion of a limited pump test conducted on Supply Well No. 2 in Section 9.4.3 (Table 9.1).

2.4.2 Soil Types (Surface and Vadose Zone)

Soils in the mine area are composed of alluvial material eroded from the nearby highlands. They vary in depth from zero to over 40 feet and are primarily composed of quartz and feldspar minerals derived from the quartz monzonite bedrock. A poorly developed A-horizon soil exists in the upper six-inches of the alluvial materials (VGC, 1994).

2.4.3 Surface Water Hydrology and Hydrogeology

No native surface water exists at the Morning Star Mine except for brief ephemeral flows as the result of precipitation (VGC, 1994). No flowing springs or flowing surface water were noted during either the 1995 investigation (CCJM, 1996) or subsequent sampling episodes (E & E, 1996 and HLA, 1999, 2000, 2001 and Harding ESE, 2002).

Water does exist in the bottom of the open pit and in the PSP, both man-made facilities. Refer to Sections 3.0 and 5.0 for a discussion of additional soil and water analyses conducted on mine waters.

2.5 Surrounding Land Use and Populations

Land use in the vicinity of the mine site consists primarily of dispersed recreation within the Mojave National Preserve. The nearest population center to the project site is Nipton, approximately 20 miles east of the mine. The mine's service center was Las Vegas, approximately 65 miles to the northeast. Historically, most of the residents in the area of the mine were employed in mining and ranching. Government (county, state and federal) was also a major employer. With the decline in the mining industry, "visitor services" and government remain the area's largest employment sectors.

2.5.1 Residential, Industrial, and Commercial Land Use

There are no residences or schools supplied by ground water within a four-mile radius of the mine site. Numerous inactive and abandoned mines are located in the vicinity of the mine site. No active sites are within a four-mile radius of the site. Livestock grazing has occurred on the Mojave since European settlement of the west. The long-term management goal for the Preserve as stated in the Revised Draft Environmental Impact Statement General Management Plan is to retire all grazing permits over a period of time (MNP, 2001).

2.5.2 Possible Pathways of Exposure

Possible pathways of exposure include surface water, groundwater, airborne particulate, and direct exposure to hazardous substances and contamination.

2.5.2.1 Surface Water

The surface water hazardous substance pathway is composed of any man-made conveyances such as ditches and ponds as well as naturally occurring surface water drainages within the vicinity of the mine. The LRWQCB classified the PSP as "Waters of the State of California," resulting in its consideration both as a source of hazardous materials as well as a surface water body (CCJM, 1996). Ephemeral drainages adjacent to the mine ultimately drain into the normally dry Ivanpah Lake approximately 13 miles downgradient of the mine site. Review of the Site Features Map, BLM Morning Star Mine Preliminary Assessment (CCJM, 1996), does not indicate the presence of any ditches constructed to convey stormwater flow, although the Operating Plan indicates such structures are present (VGC, 1994). Surface water as storm water or runoff/overflow from Pad No.1, Pad No.2 and the PSP would enter ephemeral drainages to the southwest and southeast of the site. It is anticipated that this water, transporting sediments toward the Ivanpah Valley from

the mine site, would evaporate or infiltrate the coarse native soils before reaching the normally dry Ivanpah Lake.

No drinking water from surface water sources is located in the vicinity of the mine. There is no indication that surface water is used for any resource purposes; however, livestock corrals are located adjacent to the ephemeral wash.

2.5.2.2 Groundwater

The contamination pathway for groundwater could be through the Ivanpah Quaternary Alluvium and faults and fracture zones within the Ivanpah Granite formation. The only well known to be used for potable purposes during the Preliminary Assessment investigation (CCJM, 1996) was the onsite water supply well located upgradient of the leach pads and PSP. Data necessary to characterize local groundwater occurrence, hydraulic gradient and contaminant fate and pathway is minimal, however, site documents report its depth is over 200 feet bgs (VGC, 1994). A release to groundwater is possible given the volume of the potential waste sources, the suspected lack of integrity of the pad liners, and the hydrologic mobility of the hazardous materials present.

2.5.2.3 Airborne Particulate

The prevailing wind is from the south-southwest and is influenced by the north-south orientation of the Ivanpah Mountains (CCJM, 1996). No waste containment for particulate migration currently exists on site. None of the potential sources of hazardous materials (the two pads and the PSP) have had any kind of a protective cover installed. There is a potential for both heavy metals and cyanide in the form of fine particulate matter to migrate off site in accordance with prevailing wind patterns.

2.5.2.4 Cyanide Gas

Solutions containing cyanide must be maintained at a pH level of over 9.5 SU to keep cyanide from volatilizing in the form of hydrogen cyanide gas (U.S. Fish and Wildlife Service, 1995). Once the mine ceased maintenance operations, pH levels in leach pad waters were no longer adjusted to maintain the alkalinity levels required to keep cyanide gas from forming. Levels of pH at the mine ranged from 6.6 at the bottom of the PSP to 8.5 in standing water on the south side of Pad No.2 (HLA, 2000). Neither pH level is sufficiently high to prevent the volatilization of sodium cyanide as hydrogen cyanide gas.

2.5.3 Identification of Sensitive Populations

“Sensitive population” is a broad term that can include descriptions of sensitive species, species of special concern, endangered, or threatened. A sensitive species analysis of the Northern and Eastern Mojave Planning Area identified 175 plant and animal species of special consideration (NPS, 2000 and 2001). These included endangered, threatened, proposed, or candidate species under both federal and state Endangered Species Acts as well as agency-defined sensitive or endemic species of special concern.

Habitats that support one or more species of special consideration were termed “sensitive habitats.” These included riparian, wetland, sand dune and wash habitats, as well as key habitats for desert tortoise, bats, bighorn sheep, certain plants, and a variety of endemic species (NPS, 2000). The only species identified in the biological report completed by the operator that appears on this list is the loggerhead shrike (*Lanius ludovicianus*) (VGC, 1994). The loggerhead shrike is listed as a California State sensitive species.

Correspondence from regulatory agencies in the historic record indicate the mine is located within a waterfowl migration route. Surface water in both the open pit and PSP could pose a threat to migrating waterfowl; during operations the mine was cited for wildlife mortalities associated with cyanide exposure from the PSP (CCJM, 1996).

The General Management Plan (NPS, 2002) identified confirmed populations or potentially viable habitat for three federally endangered, one federally threatened, six state (California) endangered and one state threatened wildlife species. Federally listed species are the desert tortoise (*Gopherus agassizii*) and the Mohave tui chub (*Gila bicolor mohavensis*). Final recovery plans have been prepared for both species. The southwestern willow flycatcher (*Empidonax traillii extimus*) and least Bells vireo (*Vireo bellii pusillus*) are listed birds that typically utilize riparian areas. Neither is anticipated to utilize the vicinity of the mine.

California state-listed wildlife species include the desert tortoise, the Mohave tui chub, and the willow flycatcher (*Empidonax traillii*). The California (or western) yellow-billed cuckoo (*Coccyzus americanus occidentalis*) is also more likely to be observed in riparian areas. There is probably little potential for the cuckoo to be present in the Preserve (NPS, 2002).

2.5.4 Estimate of Sensitive Population Densities within Potentially Affected Radius

The National Park Service inventory and monitoring program of sensitive species populations are ongoing. Results are not known at this time.

2.5.5 National Historic Preservation Act Considerations

While there are several features within the Preserve of either cultural or historic interest (NPS, 2000), no National Historic Preservation Act considerations are known at this time to occur within the mine project boundary.

2.6 Sensitive Ecosystems

2.6.1 Sensitive or Endangered Species

There are three wildlife species listed as federally endangered, one federally threatened, six state listed endangered and one state threatened plants and/or animals within the Mojave Preserve. Federally listed endangered species are the desert tortoise (*Gopherus agassizii*) and the Mohave tui chub (*Gila bicolor mohavensis*). Final recovery plans have been prepared for both species. NPS mapping indicates that the mine site is within tortoise habitat (NPS, 2002), several tortoises have been observed in the vicinity of the mine during recent site visits (Harding ESE 2001, 2002). There is no surface water at the mine except for man-made structures (the open pit and the PSP). State of California listed species include the desert tortoise and the Mojave tui chub, and the willow flycatcher (*Empidonax trailli*). The California (western) yellow-billed cuckoo (*Coccyzus americanus occidentalis*) may have some limited potential to appear in the Preserve (NPS, 2000).

There are no known federally listed or proposed candidate plant species in the Preserve. Thorne's buckwheat (*Eriogonum ericifolium* var. *thornei*) is listed by the state of California as an endangered species. It is known from only two occurrences in the Preserve's New York Mountains above 5,500 feet in elevation (NPS, 2000).

Preliminary resource management documentation indicates there may be three sensitive vegetative habitats in the Preserve (NPS, 2002). These include the Chaparral Habitat, populations of White Fir, and the Joshua Tree Woodlands in the vicinity of the Cima Dome. Both the Chaparral Habitat and the White Fir community types are located in the New York Mountains. The Chaparral Habitat is comprised of a unique pinyon-juniper-oak woodland community that includes Manzanitita (*Arctostaphylos pungens*), oaks (*Quercus chrysolepis* and *Q. turninella*)

silk tassel (*Garrya flavescens*), single-leaved ash (*Fraxinus anomala*), western service-berry (*Amelanchier utahensis*), holly-leaved redberry (*Rhamnus ilicifolia*), yerba santa (*Eriodictyon angustifolium*), and desert olive (*Forestiera neomexicana*) found in Caruthers, Keystone and Live Oak Canyons. The White Fir populations (*Abies concolor concolor*) are found in favorable microsite conditions in north-facing canyons. The Joshua Tree Woodland (*Yucca brevifolia jaegeriana*) is considered to be the largest and most dense stand within the tree's range, covering in excess of 150 square miles.

Other plant communities identified by the BLM as "unusual" include: Calicolous Scrub, Great Basin Sagebrush (*Artemisia tridentata tridentata*) Scrub, Shadscale (*Atriplex confertifolia*) Scrub, Desert Grassland, Kelso Dunes, Mojave Yucca (*Yucca schidigera*), Succulents, Riparian, Mesquite thickets and smoke tree (*Dalea spinosa*) communities. Action plans for these "unusual" plant community types include inventorying, monitoring and studying them to determine appropriate management actions (NPS, 2002). None of these sensitive habitats have been mapped within the vicinity of the mine.

The Biotic Resources Report conducted for VGC (VGC, 1984) conducted a search limited to the project site for the Gila monster (*Heloderma suspectum*) and the desert tortoise (*Gopherus agassizii*). None were located. A subsequent survey reported locating one tortoise and a few burrows (VGC, 1988); however no details are available at the present time regarding location. The desert tortoise habitat in the vicinity of the site could be affected by the presence of airborne particulate matter containing heavy metals and cyanide.

Other wildlife noted in the vicinity of the mine (VGC) included the blacktail jackrabbit (*Lepus californicus*), the Audubon's cottontail (*Sylvilagus auduboni*) and the coyote (*Canis latrans*). The desert woodrat (*Neotoma lepida*) was abundant, with the Merriam kangaroo rat (*Dipodomys merriami*); the Panamint kangaroo rat (*Dipodomys panamintius*) and the western Pipistrelle bat (*Pipistrellus hesperus*) were occasionally present. Incidental observations of Harding ESE staff on site during installation of the Interim Measures included a bobcat (?), mule deer, unidentified raptors, quail and burros.

2.6.2 Wild and Scenic Rivers

There are no wild and scenic rivers within the study area. The unnamed ephemeral washes to the southwest and southeast of the mine site are incapable of supporting or sustaining a fisheries population.

2.6.3 Connection to Human or Other Food Chain

There were nine livestock grazing allotments in and adjacent to the Mojave National Preserve when administration of the area passed from the BLM to the NPS. A total of 1,042,434 acres comprise the grazing areas in the preserve. Two of the allotments have now been permanently retired. The Morning Star Mine site is within the Valley View grazing allotment, the second largest allotment within the preserve, with 268,000 acres within the preserve's boundaries. Perennial grazing authority is permitted on 95 percent of this allotment, with a total of 8,609 AUMs. The BLM rated the range conditions as good prior to 1992 when administration of the Mojave changed from the BLM to the National Park Service (NPS, 2000).

Wildlife and birds could be attracted to the site by the presence of surface water in the open pit and in the PSP. Airborne particulate matter containing heavy metals and cyanide could present a pathway for ground-feeding birds such as chukar and quail.

2.6.4 Wetlands, Wildlife Breeding Areas

Wetland environments associated with water in the bottom of the open pit and the habitat of the desert tortoise are the two most sensitive environments that could be affected by the air migration pathway (CCJM, 1996). A small (less than one acre) potential wetland was identified at the base of the open pit; however, no wetland delineation has been conducted for this area. No wetland indicators have been noted within or adjacent to site ephemeral washes (CCJM, 1996). No aquatic T/E species have been identified in the vicinity of the mine site; however, the desert tortoise (*Gopherus agassizii*) is associated with this portion of the Preserve (See page 14). The California Department of Fish and Game has documented an occurrence of the desert tortoise approximately 6.5 miles northeast of the mine site. Anecdotal evidence has recorded the presence of tortoise near the mine site on the access road during a site investigation (Harding ESE, 2001). The range of the tortoise is an area of approximately 320 square miles southeast and east of the Ivanpah Mountains at elevational ranges between 2,600 to 4,500 feet amsl. The tortoise habitat is associated with desert scrub, desert wash, and creosote (CCJM, 1996).

Feral burros are an invasive, nonnative species that are using the water in the open pit as a water source. Burros compete with desert bighorns, desert tortoise and other native species for forage. The proposed management goal for the Mojave National Preserve is to remove all burros from within the preserve boundary. The revised management plan describes methods for capture, transport, and placement of the burros to ultimately achieve a zero population (NPS, 2000).

2.7 Meteorology

Meteorological data from Mountain Pass, California, a community approximately 9 miles northwest of the Morning Star Mine site, was selected to represent site conditions. Mountain Pass is the nearest site to the mine, lies within the same mountain range, and is at approximately the same elevation (average elevation of the Mountain Pass stations is 4760 feet above mean sea level and the elevation on top of Pad No. 2 is 4535 feet). No meteorological data could be found from the Morning Star Mine site. Data from Mountain Pass was obtained from the Western Regional Climate Center (WRCC) and the National Oceanic and Atmospheric Administration (NOAA). A graphical presentation of temperature and precipitation data (30-year average) is presented in Met Figure 1.

2.7.1 Rainfall/Snowfall

Annual precipitation for the 1990 through 1999 period averaged 9.5 inches per year (Met Table 1). The range was from a low of 5.9 inches in 1994 to 16.3 inches in 1992. Total snowfall during the same time period averaged 4.7 inches, with a low of 0.5 inches in 1990 and a high of 8.0 inches in 1995 and 1997. The 2-year, 24-hour rainfall event is less than one inch, and the 100-year, 24-hour event will produce about 3.0 inches of precipitation.

2.7.2 Temperature Ranges

The climate in the area is characterized by hot summers and cold winters. Annual average temperatures for the 1990 through 1999 period ranged from 49.3°F to 70.8°F (Met Table 2). Recorded monthly maximum temperatures ranged from a December high of 68°F (12/31/97) to a July high of 108°F (7/16/98). Recorded minimum monthly temperatures ranged from a December low of 3°F (12/21/90) to a July low of 50°F (7/1/92).

2.7.3 Wind Conditions

The annual prevailing wind direction is out of the southwest with an annual mean wind speed of 9 mph (Met Fig. 2).

2.7.4 Evaporation

The mean annual Class A Pan Evaporation for the area is 120 to 130 inches per year (Met Fig. 3).